MANHATTAN COLLEGE

Department of Computer Science
CMPG 767 / CMPT 477 Image Processing and Analysis
Course Syllabus

Instructor: Dr. Igor Aizenberg
Office HAY-106A
Email: igor.aizenberg@manhattan.edu
Class Hours: MR 1:30p – 2:45p

A link for the students taking this class online https://meet.google.com/arh-zeqo-wbd

Course Webpage https://www.igoraizenberg.com/my-classes/cmpg-767-image-processing-and-analysis

All students taking class in person must take it in person.
Going online can occasionally be allowed as an exception only if somebody gets sick.

Office Hours: MR 12:15p-1:15p or by appointment (mostly in Google Meet in the latter case)

Overview
This course provides the basic concepts of image processing and analysis including but not limited to image sensing and acquisition, visual perception, image enhancement, image filtering in the spatial and frequency domains, edge detection and image segmentation, blurred images restoration, image understanding and recognition, color image processing.
Practical exercises provide experience with design and software utilization of image processing and analysis algorithms and image processing is various real-world applications (medical and satellite image processing, old images restoration, and digital photography). Students will utilize various algorithms in software and use their programs for processing real images. This will help them to accomplish specified challenges as they develop problem solving skills.
A course project will help students to develop their team-working skills and get good experience of software project design.

Learning Goals/Outcomes

Upon completion of the course students will be able to:

- Use main techniques of image processing and analysis, image acquisition, sampling and quantization; image enhancement and filtering in the spatial and frequency domains; restoration of blurred images; color image processing; image segmentation; image recognition;
- Design and utilize image processing algorithms in software.

- Use algorism of image processing and analysis to process real-world images coming from medical and satellite imaging, digital photography, surveillance systems, etc.

Prerequisites

No prerequisites. The course is open for all graduate students, juniors, and seniors.

Textbooks (optional)

R. C. Gonzalez and R. E. Woods, Digital image Processing, 3rd Edition, ISBN-10: 013168728X ISBN-13: 9780131687288, Prentice Hall, Copyright: 2008.
Detailed class notes will be provided, thus a textbook is not required.

Method of Evaluation

Method of Evaluation

- Your grade will be based on your scores from
- Homework project assignments (**70%**) and
- Course project (**30%**).
  Final grades will be based on the following scale: A (95-100), A- (90-95), B+ (85-89), B (78-85), B- (75-78), C+ (70-75), C (65-70), C- (60-65), D (50-60), F (<50). The instructor reserves the right to adjust the grading percentages and scale if necessary.

  The grade "A" requirements:
  1) All homework projects assignments turned in.
  2) Final project grade 90+

- **Project assignments**

  - Project assignments will be given throughout the semester (5-6 assignments are planned).
  - Each project must be defended by presenting a written report with the results and demonstrating a working computer program.
  - Each project will be due. **1 (one) point will be deducted** for every day a project is past due

Tentative List of Topics and Schedule

Week	Topics	Reference to the Class Notes
1	Introduction. Examples of fields that use Image Processing and Image Analysis. Elements of Visual Perception.	Lecture 1
1-2	Image acquisition, sampling, and quantization.	Lecture 2
2-3	Statistical Analysis of Images	Lecture 3
3	Mathematical and Software Tools used in Image Processing. Organization of 2D data and processing of 2D arrays.	
4	Image analysis and enhancement in the spatial domain.	Lecture 4
5	Noise models. Noise Reduction. Concept of linear filtering. Low-Pass (Smoothing) Filters.	Lecture 5
6	Concept of nonlinear filtering. Order Statistic Filters. Impulse noise detection and filtering	Lecture 6
7	Image Sharpening. Edge Detection and segmentation	Lectures 7-8
8	Frequency-domain image processing. 2D Discrete Fourier Transform	Lecture 9
9	Periodic and Quasi-Periodic Noise Filtering	Lecture 10
10	Image Restoration (Deblurring)	Lecture 11
11	BM3D Filtering	Lecture 12
12	Color Image Processing	Lecture 13
13	Intelligent image filtering.	TBA
14	Object Localization. Introduction to Image Recognition	Lecture 14

Success in Class

- Read the assigned class notes as per the class discussion.
- Do as many exercises as possible even if they are not assigned.
- Ask questions about parts of reading or lecture which you do not understand.
- Get help before you are completely lost. I am available to help you via e-mail, in the classroom, or in my office.

Attendance Policy

Attendance in every class meeting is mandatory. Being in class on time is equally important. Any absence for valid reason will be required to be supported with proper documentation.

Cheating Policy

Cheating will result in zero credit for all students involved. Programming assignments may not be solved in collaboration, unless specifically stated in the assignment. You may discuss problems with each other. Where does discussion end and cheating start? You may not copy lines of code from anybody or anywhere (including books and online sources). As a general rule, if you don't understand the code and can't explain the code, you can't use the code because this

means that this code is not yours. <u>All work turned in under your name must be your own. Programming assignments must be your own work. No credit will be given for an assignment that is copied – in part or in total – from another person or from a book or any online resource including online AI tools</u>

For more information on the University Academic Integrity policy, please use the following link: https://inside.manhattan.edu/student-life/dean-of-students/code-conduct.php#academicintegrity

Note Regarding Online Artificial Intelligence (AI) Tools

Intellectual honesty is vital to an academic community and for my fair evaluation of your work. All work submitted in, must be your own, completed in accordance with the University's academic integrity regulations. You may not engage in unauthorized collaboration or use ChatGPT, Bing AI Chat or other AI composition software to design any software included in the assignments in this course. Copying software produced by online AI tools is the same plagiarism as copying software from any other unauthorized sources.

Online AI tools can occasionally be helpful for studying or better understanding concepts in this and other courses. You may ask them to give you the information related to a specific topic; you may also ask them to evaluate your understanding of some topic.

However, you need to understand that online AI tools mostly reproduce items from their big, but nevertheless limited knowledge bases than really perform intellectual work. Thus, they often perform what is called in the AI theory "symbol manipulation" rather than produce a product of actual intelligence. They may also generate incorrect answers to your questions and mislead you. You also need to understand that Image Processing is so rapidly developing area that online AI tools' knowledge base does not contain some important information, especially if it is related to any recently designed methods.

AI should be a tool to enhance your understanding, not a substitute for doing your work. One day, you will need to do your work and will probably be assisted by AI. But, if you do not understand the concepts and materials on your own, you cannot leverage AI properly. If you substitute it for doing your work, you are cheating yourself of true understanding and misrepresenting the work you're handing in as your own creation.

Student Academic Support Services | Center for Academic Success

The Center for Academic Success (CAS) is committed to providing student-centered and student-led programs and initiatives designed to enhance learning and promote success and persistence for all Manhattan College students. Students work collaboratively with qualified peers and professionals to develop knowledge, skills, and strategies needed to thrive in the classroom and beyond.

The CAS has three locations: the Learning Commons in Thomas Hall 3.11, the Leo Learning Center in Leo 117/118, and Lee Learning Commons 6th Floor. Services include online and in-person tutoring and writing center appointments, Supplemental Instruction and Writing Fellows (select courses), student success mentoring, STEM and reading/writing professional Learning Specialist support, and English language support. All services are free of charge and available to all Manhattan College students. Appointments are preferred but walk-ins are welcome when available. To make an appointment, students can log into their Jasper Connect account or visit the CAS in Thomas Hall, 3.10. Students can also contact success@manhattan.edu with any questions.

Policy on Students with Disabilities:

If you have a documented disability (or disabilities) that require(s) special accommodation(s), please contact the Specialized Resource Center via email at src@manhattan.edu. Use of services is voluntary and strictly confidential and free of charge. Once you have provided documentation to the SRC, it will be reviewed to determine appropriateness of accommodations. You will receive a completed form to present to each of your professors.

Title IX Statement

In accordance with Title IX of the Education Amendments of 1972 that prohibits discrimination on the basis of sex in educational settings that receive federal funds, Manhattan College is committed to providing an environment not impaired by sex and gender-based misconduct. For purposes of Title IX reporting, I am considered a "mandated reporter" at Manhattan College. That means I must share information related to situations involving sex discrimination and sexual harassment, including sexual assault, sexual harassment, domestic violence, dating violence, stalking, and/or retaliation with the Title IX Coordinator. Information for resources, policies, and how to file a formal report can be found at: https://inside.manhattan.edu/offices/d